

Increasing Motorist Yielding Compliance at Pedestrian Crosswalks from under 2% to as high as 94% using Rectangular Rapid Flashing Beacons - Earning it “Interim Approval” from Federal Highway Administration.

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BACKGROUND

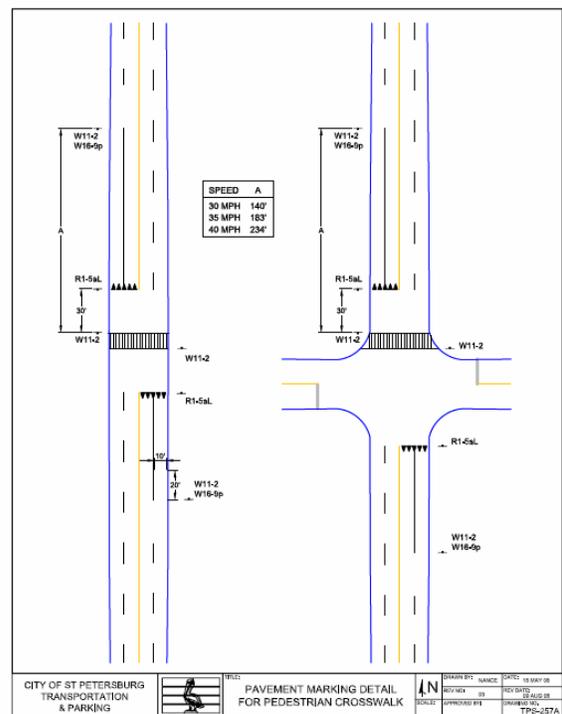
The Tampa Bay region, including the City of St. Petersburg, has been identified by the Surface Transportation Policy Partnership in their “Means Streets” reports since 1995 as one of the worst urban areas in the country for pedestrian safety. The City considered this unacceptable and immediately started to take steps to improve conditions for pedestrians. Countermeasures have included the evaluation of solar-powered, radio controlled, pedestrian-activated, LED **R**ectangular **R**apid **F**lashing amber **B**eacons, (*RRFB*) mounted under pedestrian crosswalk signs at 19 existing uncontrolled crosswalks.

In 2003, City Council adopted the St. Petersburg CityTrails – Bicycle Pedestrian Master Plan, which included as one of its five priorities, enhancements to our uncontrolled pedestrian crosswalks. Through permission to experiment from FHWA No. 4-305(E), the City was the first to install the *RRFB* and evaluate its effectiveness to attract a motorist’s attention to the presence of a pedestrian in a crosswalk and actually induce compliance, in accordance with Section 316.130(7), Florida Statutes.

INTRODUCTION

The City of St. Petersburg currently has almost 100 uncontrolled crosswalks located at established pedestrian generators and attractors with adequate crossing demand. These locations do not meet the current pedestrian signal warrant and are typical in Florida due to urban sprawl and multi-lane, high-speed roadways that have long distances between traffic signals, where pedestrians are expected to cross safely.

A review of these crosswalks in 2003 determined that motorist yielding compliance rates were less than 2% overall, which contributed to St. Petersburg’s pedestrian injury rate of 49.23 per 100,000 population, compared with Pinellas County’s rate of 42.39 and the State’s rate of 43.23. It was imperative that action be taken immediately. So 81 crosswalks were identified and all signs and pavement markings were enhanced to include high visibility crosswalks, advance yield bars, R1-5 “Yield Here to Pedestrian” signs, R1-6 “State Law” signs and solid lane lines approaching the crosswalk.



These are all tools that are included in the MUTCD and available for use. In addition, a system wide enforcement program was introduced with weekly operations by the Police Department.

Additional enhancements included the installation of the *RRFB*, which was mounted under pedestrian crosswalk signs at 19 uncontrolled crosswalks. An *RRFB* consists of two rectangular yellow LED indications, rapidly flashing in an alternating “wig-wag” flash sequence.

RRFB – “Enhancer™”



The “Enhancer” as its called, was developed by Rick Jones, President of Stop Experts Inc. Permission to Experiment was filed with FHWA and granted on February 28, 2006 and the first locations were installed in March 2006.

The evaluation requires that motorist compliance rates at the *RRFB* locations be compared with conventional over-head and side-mounted round flashing amber beacons. Crossing studies are required to be conducted for up to one year after installation to determine the lasting effect of the device.

SCOPE

The purpose of the study was to examine the effects of installing the *RRFB*, mounted under the pedestrian crosswalk sign located at the crosswalk. If this treatment produced results equal to or better than the standard overhead or side mounted round flashing beacon or in-roadway beacons and produced

clear safety benefits, it could be a viable alternative to use of these treatments.

ANALYSIS

Base data was collected at all 19 pedestrian crosswalk location after enhancements to the existing crosswalk were installed, which included the signs and markings package. This provided a comparative base where only the beacons were being evaluated.

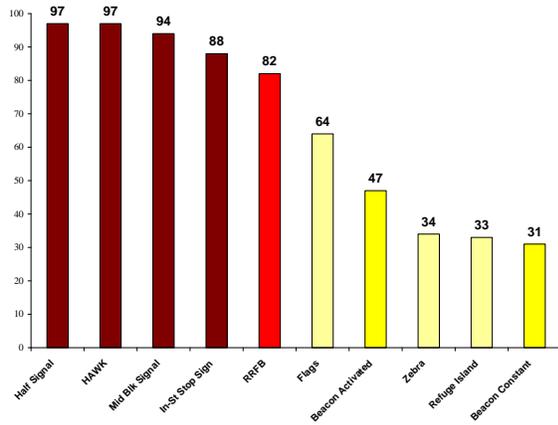
Data was then collected at one location that included a dual overhead amber flashing beacon and at two locations that included side-mounted amber flashing beacons, where the round amber beacon was installed over the pedestrian crosswalk sign at the crosswalk, in accordance with the MUTCD.



Round Amber Beacon Test Site

Base compliance rates at the 19 crosswalks averaged 1.55%, with a high of 8.14% and a low of 0.00%. The dual overhead round amber flashing beacon site reached a 15.50% yielding rate and the two side-mounted sites averaged 11.48% after two reviews. Standard crossing protocol was used at all evaluations with a staged pedestrian and a minimum of 70 crossing attempts were included in each crossing evaluation.

This analysis compares favorably with previous studies conducted by Turner et. al⁽¹⁾, where they compared several treatments to increase motorist yielding to pedestrians at unsignalized intersections.



Innovative Crosswalk Treatments

The research team collected data on motorist yielding behavior at 42 crosswalks in different regions of the United States. The results indicated that only devices with a red indication were effective at increasing yielding behavior at uncontrolled crosswalks on multi-lane roads to obtain compliance rates greater than 90%.

The Turner et. al. study also found that amber flashing beacons produced driver yielding levels of 47% and 31% on multi-lane roads. Similar results have been obtained in other studies. For example, Van Winkler and Neal ⁽²⁾ found that pedestrian activated overhead flashing beacons increased yielding from 8.5% to 42% and that yielding remained at 50% at long term follow-up.

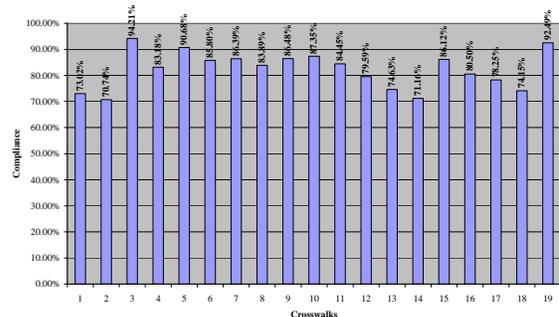
An alternative amber indication involves the use of in-roadway lights. A comprehensive study in California ⁽³⁾ found that in-roadway lights increased daytime yielding from 28% to 53% and a Florida study ⁽⁴⁾ showed increases from 28% to 53%. These data were the first to show that amber indications can produce intermediate levels of yielding behavior.

RESULTS

Since the initial installation of the first *RRFB*, crossing evaluations conducted in the same manner as the base studies have been completed to measure motorist yielding compliance after 7 days, 30 days, 60 days, 90 days, 180 days, 270 days and 365 days, at each location. This has resulted in 228 crosswalk observations conducted to date.

Based on these data we have achieved an overall system wide average motorist yielding compliance rate of **82.27%**. (Compared to the base rate of 1.55%, the side mounted round beacon of 11.48% and the overhead of 15.50%).

Rates vary between a low of 71% and a high of 94%, depending on the roadway profile and whether there is an *RRFB* located in the center median. Traffic volumes average 14,000 vpd, but several site are as high as 20,000 vpd. Vehicle operating speeds at all 19 locations average 48 MPH and 12 of the 19 locations are on a 4-lane divided roadway.



Average Motorist Yielding Compliance Rates by Location

It should also be noted that even though the average motorist yielding rate is 82.27%, during all of our 228 crossing studies, involving 15,960 crossings, we always were able to induce a safe gap to cross the roadway stopping oncoming traffic in both directions during the operational cycle of the *RRFB*'s. (Clearance varied by location, between 20 to 30 seconds.)

The only other devices to achieve this level of motorist compliance have red indications. Unfortunately, traffic signals, in-roadway

lighting and yellow beacons are all relatively expensive to install.

Crash Experience

In the five year period prior to the installation of the *RRFB* there were a total of 6 reported injury crashes “at” the 19 crosswalk locations. However, over 60% of our pedestrians crashes are reported crossing away from the marked crosswalks. Detailed data is therefore not significant.

Since the installation of the *RRFB* there has been a total of four reported crashes, none fatalities. Three of the crashes were rear end at one location, where driver 1 had stopped for the pedestrian and was rear-ended by an inattentive motorist. One crash involved a motorist that slowed for the crosswalk and the pedestrian walked into the side of the vehicle. The *RRFB* beacons were activated at all locations in each crash.

At the start of the experimentation some thought that the *RRFB* would increase rear-end crashes, similar to what the installation of a new traffic signal might. With the exception of the one site, that is located 200 feet from a traffic signal; our research has determined the opposite. Motorists are yielding far beyond the yield bars that are set at 30 feet from the crosswalk. Often motorists are yielding over 100 feet from the crosswalk and beyond. In addition, local reports indicate that the *RRFB* are attracting more pedestrians to the marked crosswalk.

Follow-Up Studies:

The City of St. Petersburg plans to complete 2-year studies at all 19 locations. Data collected will verify the sustained long-term effectiveness on the *RRFB*.

Research is currently underway is replicating these findings at different sites in various regions of the U.S. Also under experimentation are Miami Florida, Washington DC., Mundelein Illinois and Los Cruces New Mexico. Data collected to

date at these sites are similar to the data collected in St. Petersburg. Baseline levels were similar, but the treatment results obtained observing yielding to local residents crossing was somewhat better than the results obtained from staged crossings.

These data suggest that the data collected in St. Petersburg might somewhat under represent the magnitude of the effects produced by the *RRFB*.



RRFB - 22nd Avenue N / 5th Street:

CONCLUSION

The results of this study indicate that the use of the *RRFB* increased motorist yielding rates significantly. These results showed clear safety benefits associated with the introduction of the pedestrian-activated device. One reason why this device is so effective may be related to the salience of the rapid flash sequence.

Another reason may be related to the direct correlation between the pedestrians sign and the flashing device. The flashing device likely produces driver orientation to the pedestrian sign and making it stand out from the clutter.

The correlation between the flashing beacon and sign with the presence of a pedestrian crossing the street likely helps establish and maintain control of the sign over driver behavior. Along with the increases in yielding percentages is the increase in yielding at great distances. This is also an important effect. With motorists yielding at further distances, the chance that a

pedestrian may be struck by a motorist due to the inability to see the pedestrian due to a yielding vehicle is greatly reduced.

The increases in yielding percentages and the yielding distances are, as should be, associated with a drastic decrease in the number of vehicle passes, or attempts. This may also be due to the fact that, when activated, the signs are visible to all motorists and not only those in the direct field of vision to the pedestrian.

The efficacy of standard overhead beacon systems appears to be minimal at best at the test sites. There was only a small increase over baseline with the activation of the standard beacon. The *RRFB* was installed and evaluated at the same location and produced yielding percentages of 88.7%. Since these numbers were recorded at the same site with the only differences being the device used, it is assumed that these effects are true. The differences must then be due to the *RRFB* system being more visible and in the line-of-site to the motorists, as opposed to being highly elevated.

This treatment has produced results equal to or better than the standard overhead or side mounted round flashing beacon or in-roadway lights and produced clear safety benefits. When included with other traffic calming techniques, the *RRFB* compares favorably with a mid-block traffic signal.

The only other devices to achieve this level of compliance have red indications.

Based on the significant research completed to date, the *RRFB* has proven to be a viable and cost effective alternative to existing features in the pedestrian safety tool box.

CURRENT STATUS

With the success of this experimentation as well as others currently underway at locations across the country, the *RRFB* has earned “Interim Approval” from FHWA for inclusion in the MUTCD. So now other jurisdictions can add it to their toolbox and increase traffic safety at pedestrian crosswalks nationwide.

For technical conditions of Interim Approval and memorandum see the FHWA web site: http://mutcd.fhwa.dot.gov/res-interim_approvals.htm

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